1975

Alternative Pasture and Forage Systems

Cooperative Extension South Dakota State University

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FS 631
(replaces FS 307)

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COOPERATIVE EXTENSION SERVICE
SOUTH DAKOTA STATE UNIVERSITY
U. S. DEPARTMENT OF AGRICULTURE

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Alternative Pasture and Forage Systems

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Livestock numbers, feed prices and land prices in South Dakota have been increasing annually, but the number of acres available for production of feed and forage has not. Cattle numbers have passed the 5.5 million mark for the first time in 40 years. Feed costs have doubled and, in some cases, tripled in the last year or so. Livestock prices have not increased materially and the livestock producer is in the biggest cost-price squeeze that he has experienced in many years.

The livestock producer must use the most economical system for raising cattle or sheep if he is to stay in business. This publication discusses some of the pasture and forage alternatives for use between mid-April and November.

We ordinarily think about using pasture and range. However, research results indicate that grazing pasture and range is not always the most economical method. At the Pasture Research Center in north-central South Dakota, a cow-calf herd was managed under three systems. One system included 15 cow-calf pairs on 100-acre pastures for 181 days. (They were fed hay the remainder of the year). Over a 6-year period 47 pounds of beef were annually available for sale from each acre at a cost of $37.96 for each cow with a net return of $24.79 per cow. A second system included 200 days of grazing and 165 days of hay with 10 cow-calf pairs on 40-acre pastures. Pasture included the rotation grazing of four different tame-grass pastures. More beef was produced (71 pounds per acre) but cost was higher ($71.35 per cow) and return for labor and management was lower ($12.25 per cow). The third system included 128 days of grazing on tame pasture and 237 days of hay, with 10 cow-calf pairs on 32-acre pastures. Beef production was 74 pounds per acre, costs were $44.43 per cow and returns for labor and management were $39.96 per cow, indicating that the use of hay for a longer season yielded the best returns per cow, the best returns per hour of labor and the best returns per acre. These results do not include any charges for labor or land nor any allowance for wastage of hay in feeding.

Other data indicate that more forage is produced if cut for hay than when grazed. In Turner County, a bromegrass-intermediate wheatgrass-alfalfa pasture produced 990 pounds of air-dry forage when clipped three times to simulate grazing and 1230 pounds when cut for hay. On fertilized pasture at the same location, yields were about ¾ ton per acre when clipped three times and almost 1 ton when cut for hay. If forage is cut for hay, it is possible to have a higher percentage of alfalfa in a grass-alfalfa mixture and it produces more forage than grass. Where an alfalfa-grass hay mixture produces 2 tons of hay, a grass-alfalfa pasture yields only slightly more than 1 ton.

These research results indicate that best returns for investment, labor and management might be obtained if hay were fed 12 months of the year, and prompted us to make the cost estimates found later in this publication. Since costs are governed by type of forage used, management and land values, all of these factors are discussed so that a producer can adjust our estimates to fit his situations. He can estimate the cost and number of acres required for forage production or pasture for more than 35 different systems that will cover a 6½-month period between mid-April and early November.

LAND CHARGES

Land charges are estimated to be 7% for return on investment and 1% for taxes. We have used land values of $250 per acre ($150 for native pasture) which will fit many eastern counties and $130 per acre ($100 for native) which will fit many central counties. Our estimates can be adjusted to fit areas with either higher or lower land values.

FORAGE SPECIES

Studies that illustrate the value of tame grasses in a pasture mixture were conducted at Huron and Norbeck and at Mandan, ND. At Huron, native grass (largely western wheatgrass and blue grama) produced a 3-year average yield of 0.67 ton of hay or 95 pounds of animal gain per acre. Native grass that had been fertilized each year with 100 pounds of ammonium nitrate (33.5 lb of N) produced slightly more—1.0 ton of forage and 100 pounds of gain per acre. However, the yield was doubled in a bromegrass-alfalfa pasture that was fertilized annually with 45 to 115 pounds of phosphate (P_2O_5) per acre. It produced 2.0 tons of forage and 296 pounds of animal gain per acre.

At the Pasture Research Center near Norbeck, native grass produced 0.87 animal unit month (AUM) of grazing per acre, while a mixture of bromegrass-intermediate wheatgrass and Teton alfalfa produced 1.32 AUM's of grazing per acre during 6 grazing seasons.

At Mandan, native range produced an average of 42 pounds of animal gain per acre. Crested wheatgrass produced more than twice as much under spring use—a 28-year-old pasture produced an average of 89 pounds and a 6-year-old pasture produced 104 pounds.

In the past the additional cost of maintenance and re-establishment

of tame grasses often nullified the advantages of increased production. Tame grasses generally became sod-bound, and production was seriously reduced in 4 or 5 years unless nitrogen fertilizer was applied. Most people did not use fertilizer. Haytype alfalfas were often planted in a mixture to furnish nitrogen for the grasses and to improve quantity and quality of forage produced. As a general rule the stand of alfalfa was depleted in 4 or 5 years and the grass then became sod-bound. Cost of reestablishment reduced the net profit from the pasture.

With the newer, pasture-type alfalfa varieties this problem is diminished. The pasture-type alfalfa is much more persistent under grazing than the older hay-type varieties. When a pasture-type alfalfa is planted with tame grasses and is fertilized properly, it is anticipated that tame grasses will continue to be productive for 12 to 15 years. At Brookings, pastures composed of Teton alfalfa and either bromegrass or intermediate wheatgrass were more productive after 7 years than at the end of the first pasture season. At Norbeck a mixture of Teton alfalfa, bromegrass and intermediate wheatgrass is in excellent condition after 9 years of grazing under two different management systems.

Grass Mixtures

It is sometimes desirable to use two grass species and a legume in a pasture mixture. Early growing cool-season grasses should not be mixed with later cool-season grasses; cool season grasses should not be mixed with warm-season grasses. Figure 1 illustrates that some cool-season grasses, such as crested wheatgrass, Russian wildrye, and Kentucky bluegrass, start growth early in the spring. Smooth bromegrass, intermediate wheatgrass and cool-season natives (western wheatgrass, needlegrasses, etc.) start somewhat later, but before warm-season grasses (switchgrass, yellow Indiangrass, bluestems, gramas and others), which do not start growth until late in the spring. All are not ready for grazing or mowing at the same time. Later-emerging grasses mixed and grazed with the earlier grasses suffer a loss of root reserves and do not give maximum forage production.

Grasses with jointed stems produce more forage when managed with a rotational grazing system. Grasses without jointed stems do better under a system of continuous moderate grazing and can be grazed earlier. Mixing the two types results in mismanagement of either one or the other. For more detailed information see Fact Sheet "Grazing Management Based on How Grasses Grow."

Likewise, there are few if any known instances where a mixture of native and domesticated plants are maintained under grazing use with satisfactory production of both kinds. The management which favored one group has worked to the detriment of the other.

Grass-Legume Mixtures

A grass-legume mixture yields more forage with higher percentage of protein than grass alone. Consequently, it produces more pounds of animal product per ace. A grass-legume pasture should contain 35 to 50% pasture-type alfalfa. An alfalfa-grass hay crop should contain 80% of a hay-type alfalfa. The value of alfalfa in a pasture mixture has been demonstrated in numerous studies. At Brookings, for instance, a smooth bromegrass-alfalfa pasture produced an average of 308 pounds of animal gain per acre over a 5-year period. Fertilized smooth bromegrass without alfalfa produced only 236 pounds of gain. At 1975 prices, the annual cost of fertilizer was $14.30 per acre for the grass and $5 for the alfalfa-grass mixture. Likewise, a combination of crested wheatgrass and alfalfa produced an average of 142 pounds of gain per acre over a 12-year period at Mandan, ND, while crested wheatgrass alone produced only 104 pounds. Under irrigation at Newell, a smooth bromegrass-orchardgrass-alfalfa pasture produced an average of 334 pounds of beef per acre over a 3-year period while the grasses produced 275 pounds of gain. Fertilizer costs were $14.25 per acre for the grass-alfalfa mixture and $42.25 for the grasses alone—the alfalfa provided about $28 worth of nitrogen.

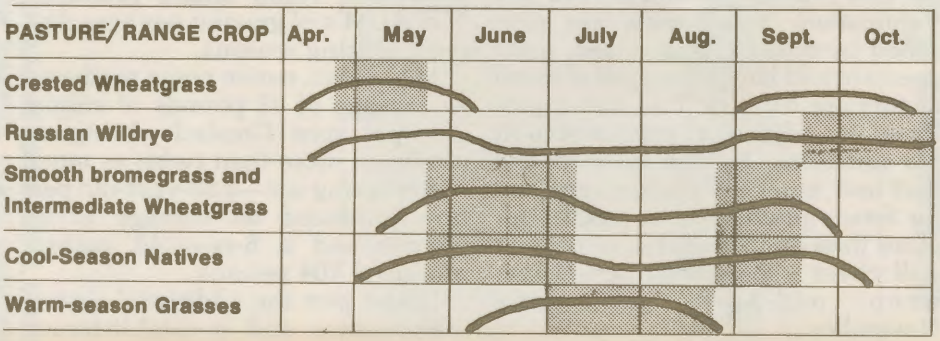
The value of alfalfa depends on the price of beef. If beef was worth $30 per cwt, the alfalfa increased net income $30.90 per acre at Brookings, $11.40 at Mandan and $45.70 at Newell.

Since the South Dakota trials indicate that 60 to 70 more pounds of beef per acre can be raised if alfalfa is included in the mixture, it means that an operator can afford to lose from bloat or other causes a 900-1000 pound animal on every 15 acres without actually losing any money. If he does not lose an animal on each 15 acres each year, the alfalfa is increasing his net income.

Similarly, dairy cows at Rosemount, MN, were grazed on (1) an all-grass pasture composed of bromegrass and orchardgrass, (2) a simple mixture of these grasses with hay-type alfalfa and ladino clover, and (3) a complex mixture of four grasses and four legumes. The grass-legume pastures out-yielded the fertilized, all-grass pasture. After the first year when the clover winterkilled, bromegrass and alfalfa made the only significant contributions to forage production in the grass-legume mixtures.

Hay-type alfalfas such as Vernal, Ranger and Ladak have been used in pasture mixtures. However, they have an erect type of growth. They grow as tall as the grasses and their regrowth is more rapid, resulting in differential grazing. For this reason hay-type alfalfas sometimes cause bloat in cattle or sheep if they make up more than 50% of the forage. In comparison, pasture-type alfalfas

Figure 1. Growing season of several groups of grasses with five grazing periods (Table 1) superimposed.



such as Rambler, Teton and Travois are less erect, having a decumbent (lying on the ground) type of growth. They are slow to recover after being grazed—their regrowth rate is comparable to grass. Thus, grazing animals eat nearly equal amounts of grass and legume and the probability of bloat is much less than with hay-type alfalfas. The type of management of grass-legume mixture should be determined by the characteristics of the grass when pasture-type alfalfas are used.

GRAZING SYSTEMS

The most common grazing system is **continuous grazing**. The grazing season may be short or long, but once the livestock are placed on the pasture, they are not removed until the end of the grazing season. Continuous grazing at a moderate rate for a specific season appears to be the best way to utilize grasses with unjointed stems such as Kentucky bluegrass and most native ranges.

Seasonal **pasture rotation** is the movement of livestock from one pasture to another in order to graze the grass species in each at the desired stage of growth.

Rotation grazing is the movement of livestock among pasture subdivisions several times during the grazing season, so that the grass is harvested at a certain stage of development. This system requires more fencing and more water development, but it is especially beneficial to tame pastures composed entirely of grasses with jointed stems such as smooth brome. The principles of rotation grazing are discussed in the Fact Sheet entitled "Grazing Management Based on How Grasses Grow."

Deferred grazing means delayed grazing and is useful to improve native ranges, or to save pastures for grazing in late summer, fall, or winter. Usually ranges are rested for improvement until the desirable range plants have reached a certain stage of growth in order to allow them to gain vigor and reproduce. A range may be divided into pastures which are deferred in different years according to a definite plan. This is called **rotational deferment** or **deferred rotation** grazing.

The benefits of the various grazing systems on the mixed prairie ranges are not fully known yet. Ranges can be improved more rapidly by use of deferment than by continuous grazing.

Season of Growth

Grasses produce more forage if grazed during the season of rapid growth. Figure 1 shows the season of most rapid growth for several groups of grasses.

Cool-season grasses produce the most forage during the cool days of spring, early summer, and autumn; warm-season grasses produce more forage in July and August when the weather is warm.

FORAGES FOR FIVE 30- TO 45-DAY PERIODS

It is possible to graze green grass for 6½ months between late April and early November by grazing each of several species during the season that it is most productive. This 6½-month period can be divided into five 30- to 45-day periods as was done at the Pasture Research Center. Table 1 shows the five periods, the pasture mixtures that were used during each period, and the carrying capacity of each.

Table 2 gives a comparison of nutritive requirements of cows and yearlings with nutrient content of tame grass pastures, native pastures, hay, silage and straw (stubble).

Early Spring (mid-April to late May)

Early spring is a critical period in a cow's life. She has her calf and starts to recuperate from the winter. She must supply milk for the new-born calf and get in condition for recycling and the breeding season.

Forages most commonly available are hay, silage, dry grass that has stood over winter and, in late-April,

Table 1. Periods of grazing when four pasture mixtures were in rapid growth stage, and the stocking rate on each at the Pasture Research Center.

DATES OF GRAZING	PASTURE MIXTURE	NO. OF DAYS	AU/A	AUM/A
Mid-Apr. to late May 4/19-5/24	Crested wheatgrass	35	0.8	1.67
Late May to early July 5/25-7/8	Brome-Int.wht-Alf	45	1.2	1.24
Early July to mid-Aug. 7/9-8/17	Switchgrass	40	1.00	1.32
Mid-Aug. to mid-Sept. 8/18-9/16	Brome-Int.wht-Alf	30	1.2	0.83
Mid-Sept. to early Nov. 9/17-10/31	Russ. wildrye	45	1.00	1.67
		200	4.0	1.70

Table 2. Nutritional requirements of cattle and the nutritive value of good quality forage commonly used between April and November.

	PROTEIN %	PHOSPHORUS %	TDN %
Cow needs	9.2	0.23	60
Yearling needs	10.0	0.30	60
Crested wheatgrass (65-0-0)	15-20	0.20	65
Brome pasture (0-0-0)	18-20	0.19-.22	65
Brome pasture (80-20-0)	20-24	0.21-.25	65
Brome-alfalfa pasture	19.5	0.36	61
Green needlegrass	10	0.16	58
Sudangrass	14.0	0.31	58
Switchgrass	10	—	64
Warm native	11	0.16	58
Alfalfa-brome hay	16	0.26	55
Corn silage	8.5	0.21	68
Barley straw	4.1	0.09	41
Dry grass (standing residue)	3.5	0.08	48

Table 3. Carrying capacity and costs of forages and supplements for a cow and calf during a 5-week period in late April and May.

FORAGE	COST PER A	PRODUCTION T/A	PRODUCTION A/AU	COST PER ANIMAL UNIT FORAGE*	COST PER ANIMAL UNIT SUPPLEMENT*	COST PER ANIMAL UNIT TOTAL
LAND VALUE $250/A						
Crested wheat pasture	$32.60	—	0.70	$22.80	$0.50	$23.30
Alfalfa-grass hay	62.15	2	0.245	15.25	7.00	22.25
Corn silage	126.75	10	0.121	15.30	2.10	17.40
Silage and hay	—	—	0.145	14.75	.50	15.25
Dry grass (standing residue)	—	—	—	—	7.00	7.00
LAND VALUE $130/A						
Crested wheat pasture	23.00	—	0.80	18.40	0.50	18.90
Alfalfa-grass hay	44.90	1.2	0.409	18.35	7.00	25.35
Corn silage	98.15	6	0.201	19.75	2.10	21.85
Silage and hay	—	—	0.24	19.00	.50	19.50
Dry grass (standing residue)	—	—	—	—	7.00	7.00

*Hay 22 lb/day or silage 60 lb/day or hay 5 lb and silage 45 lb/day allowing losses of 15% for silage and 27% hay from spoilage and wastage.
**Phosphorus for all forages, 3½ lb/day of corn with hay and ½lb/day of 40% protein with silage. 2 lb/day of protein with dry grass.

new growth of early cool-season grasses. The data in Table 2 indicate that alfalfa-brome hay should be supplemented with energy (corn or other concentrate), crested wheatgrass pasture with phosphorus, and silage with phosphorus and protein. Dry grass residue is very low in nutritive value. Green grass or a combination of alfalfa hay and silage come closest to meeting a cow's nutritional needs.

Table 3 gives a comparison of forage costs for an animal unit during the 5-week period between mid-April and late May in two general areas where forage yields and land values differ. It appears to be more economical to leave cattle in drylot on higher-priced land. Crested wheatgrass requires about ½ acre more land for each animal unit and costs about $8 more on higher value land but about the same on average value land. Since the cost for crested wheatgrass pasture includes about $11.50 per acre for fertilizer, the cost per cow can be reduced by about $8 on the higher value land and over $9 on the lower value land by mixing alfalfa with the grass and letting the alfalfa provide the nitrogen needed by the grass. If the alfalfa is cut for hay, the costs per cow are reduced even further. Crested wheatgrass requires less labor in the spring of the year.

General recommendations for late April and early May are to feed alfalfa-grass hay and corn silage until mid-May on higher value land in eastern South Dakota. On lower value land in the western 75% of the state, use crested wheatgrass-alfalfa pastures whenever practical for grazing. Use ⅔ to 1 acre for each animal unit. Cut for a hay crop in late June. Russian wildrye, winter rye, and cool-season native range, deferred for spring use, are ready at this time. Kentucky bluegrass is of most value in May. Use reed canarygrass and/or creeping foxtail for low, wet areas. Graze continuously.

If you use standing grass residue from last year's growth, be sure to supplement it properly to get the cow in condition for the breeding season. This will help ensure a good calf crop.

Crested wheatgrass and Russian wildrye are early-emerging, cool-season grasses adapted to most of the state. Both are bunch-type grasses which do not give good erosion control on steep slopes. They are useful for livestock producers who start grazing before mid-May. Stock can be moved out of the barnyard when the yards are muddy and other spring work occupies the producer's time. On the other hand, these grasses are not needed by the producer who likes to "calve" in drylot.

Crested wheatgrass is not overly productive in eastern counties. Where a late spring and summer pasture of tame grasses can be grazed by mid-May, it may be more profitable to keep the livestock in drylot for an additional 4 to 5 weeks than to utilize land for a relatively low-yielding crop of grass. Fewer acres are required to raise the forage fed in drylot than are needed for a crested wheatgrass pasture.

The economic status of crested wheatgrass may be improved in at least two ways. Harvest a crop of seed after the livestock have been shifted from crested wheatgrass to other pastures. Or harvest a hay crop from the crested wheatgrass-alfalfa pasture after the livestock have been moved to other pastures. Either procedure makes it possible to get increased production from the early spring pasture without restricting its usefulness.

Kentucky bluegrass pastures that are too rocky or rolling to seed to new species are best used during May and early June. Bluegrass does not have jointed stems and can be grazed continuously for about a month. Many bluegrass pastures can be improved by weed control, fertilization, and interseeding portions of the pasture with early-emerging, cool-season grasses and legumes.

Ranches on which special early-season tame pastures are not feasible can still have early, green forage by deferring for spring use a native range that supports mostly cool-season grasses such as western wheatgrass, green needlegrass, or needle-and-thread. In most years such ranges, when high in vigor, will provide green forage in adequate amounts by about mid-April. If grazing is continued past mid-May, spring deferment should be provided about one year in four.

Late Spring and Summer (Late May to Early July)

Tame grasses (smooth bromegrass and intermediate wheatgrass) and native cool-season grasses (western wheatgrass and needlegrasses) are most productive during this 6½-week period. Fertilized bromegrass pasture or a brome-alfalfa pasture will provide the nutrients (Table 2) except salt and water, required by a cow with a calf at her side. Yearlings will require phosphorus supplementation. Native grass or alfalfa-brome hay are low in phosphorus and energy.

Forage costs for the 6½-week period are given in Table 4 for two general areas where land values and productivity are different. The lowest forage costs are for smooth bromegrass and/or intermediate wheatgrass-alfalfa pasture that is pastured intensively for 75 days. The carrying capacity and cost figures for pasture on $130-land are those obtained at the Pasture Research Center in north central South Dakota.

Forage recommendations for 6½ weeks between late May and early July are to use smooth bromegrass

Table 4. Carrying capacity and costs of forage and supplement for a cow and calf during a 6½-week period between late May to early July.

FORAGE	COST PER A	A/AU	COST PER ANIMAL UNIT		
			FORAGE	PHOSPHORUS	TOTAL
LAND VALUE $250/A ($150 for native)					
Brome-alfalfa pasture*	$20.85	0.60	$7.50	$.60	$8.10
Brome-alfalfa pasture**	20.85	1.0	8.10	.60	8.70
Native pasture***	12.60	4.0	14.25	.60	14.85
LAND VALUE $130/A ($100 for native)					
Brome-alfalfa pasture*	11.25	1.2	8.10	.60	8.70
Brome-alfalfa pasture**	11.25	3.0	15.00	.60	15.60
Native pasture***	8.60	6.25	14.60	.60	15.20

*Grazed intensively for 45 days in May-July & 30 days in Aug-Sept. (costs prorated)
**Grazed less intensively for 4 months from mid-May to mid-Sept (costs prorated)
***Grazed for 5½ months mid-May to November (costs prorated)

and/or intermediate wheatgrass mixed with alfalfa, where adapted, for pastures to be grazed between mid-May and mid-September. Pubescent wheatgrass may be added to the mixture.

Use 1 to 3 acres of pasture for each animal unit (more acres on low-producing soils and fewer on good-producing areas) if the pasture is to be grazed continuously for 4 months. Divide the pasture in half and rotate livestock every 2 to 3 weeks. Further division with rotation at shorter intervals may be desirable on high-producing pastures.

Fewer acres are needed if you graze more intensively 6½ weeks in May to July and 1 month in August and September. Use ⅝ to 1½ acres for each animal unit. Plan for a mid-summer pasture during July and August.

If you have cool-season native range in good or excellent range condition on normal soils, allow 4 to 8 acres for each animal unit from mid-May to early November (more acres in drier areas and lower range condition and fewer in wetter areas and higher range condition.)

Use reed canarygrass in low, wet areas, but do not graze while turf is soft. Use tall wheatgrass on alkaline or saline spots.

With a relatively light stocking rate on cool-season pasture, livestock do not utilize forage as fast as it is produced during cool weather (May, June, and September), but may use it faster than it is produced during warm weather (July and August). Grazing from late May to mid-September allows the use of one pasture for an entire season, but is not always the most efficient type of management. Another type of management includes a heavier stocking rate that utilizes forage from cool-season grasses as fast as it is produced during cool weather and includes the use of another pasture during warm weather.

Smooth bromegrass-alfalfa pastures and intermediate wheatgrass-alfalfa pastures at Brookings were capable of supporting 1 animal unit per acre for 4.5 months and provided 4.5 AUM/A of grazing. Some forage produced in May and June was not utilized until later. With management that utilized the forage as fast as it was produced, these pastures were capable of supporting 2 AU/A from mid-May to mid-July and again in September but only ½ AU/A during late July and August. They provided about 5.5 AUM/A of grazing. By grazing grass as it grew, it was possible to increase the carrying capacity by 1 AUM/A.

At Fargo, ND, a bromegrass-alfalfa pasture supported two to three cows per acre during May and June, but less than one cow per acre during the remainder of the season. This illustrates that the retarded growth of cool-season grasses during July and August makes it necessary to reduce herd size at that time or use a mid-summer (supplemental) pasture.

At Lincoln, NB, 189 days grazing on cool-season grasses produced 193 pounds of gain per steer while 104 days (56 days in the spring and 48 in the fall) on cool-season grasses and 85 on warm-season produced 267 pounds. A greater gain of 74 pounds was obtained by grazing green grass as fast as it was produced.

At the Pasture Research Center near Norbeck, pastures composed of smooth bromegrass, intermediate wheatgrass, and Teton alfalfa supported ⅓ AU/A for 128 days and provided 1.32 AUM/A of grazing. Similar pastures grazed more intensively from mid-May to early July and again in September supported 5/6 AU/A and provided 2.1 AUM/A of grazing. The cattle were pastured on switchgrass in July and August. By grazing green grass as fast as it grew and using a combination of cool-season and warm-season grasses, the carrying capacity of the bromegrass-wheatgrass-alfalfa mixture was increased by 60 percent.

Under the first system, 32 acres were required for 10 cows for 128 days. Under the second system, 12 acres of brome-wheatgrass-alfalfa and 10 acres of switchgrass (a total of 22 acres) were required for 10 cows for about the same period.

If brome grass and/or intermediate wheatgrass-alfalfa pastures are used for 4 months, the carrying capacity can be increased about 10% by rotation grazing. Mow half of the pasture, and graze the other half when the grass reaches the boot stage. This ensures maximum pasturage and also provides high quality hay for the winter.

At Brookings, smooth bromegrass and intermediate wheatgrass were each mixed with Teton alfalfa. Each pasture was divided into two equal parts. Cattle were turned into one pasture during the third week in May when the grass was in the boot stage. The other pasture was mowed. About 2 weeks later (early June), the grass in the mowed pasture had recovered and was 8 to 10 inches tall. The cattle were then moved to it. Seed heads on the grazed pasture were clipped (not necessary for intermediate wheatgrass) to prevent the grass from going dormant. About 3 weeks later (late June), the cattle were moved back to the pasture grazed earlier. This system continued until half of the pasture had been grazed four times, and the other half (the first mowed) had been grazed three times. Cattle were removed from both pastures in September. The smooth bromegrass-alfalfa pasture produced an average of 194 pounds of animal gain and 0.85 ton (1.7 T/A from mowed half) of hay per acre over a 5-year period. The intermediate wheatgrass-alfalfa pasture averaged 209 pounds of animal gain and 0.83 ton of hay.

Native ranges composed principally of cool-season grasses such as western wheatgrass, green needlegrass, or needle-and-thread are excellent pastures for late-spring and early-summer use. Although they do

not produce as much forage in eastern counties as adapted, tame-grass species, native grasses are permanent, do not require reseeding if managed properly, and have lower maintenance costs.

The most use possible on native pastures (ranges) while maintaining production has received much research in the United States and Canada during the past 20 years. There can be little doubt that grazing more than 40-60 percent of each year's growth is self defeating. Try to visualize how the pasture will look on November 1 and adjust your stocking rate accordingly.

Table 5. Carrying capacity and forage cost for a cow and calf during a 6-week period in mid-summer.

FORAGE	COST PER A	T/A	A/AU	FORAGE COST PER ANIMAL UNIT
LAND VALUE $250/A ($150 for native)				
Sudangrass pasture	$50.00	—	0.20	$10.00
Switchgrass pasture	832.10	—	0.70	22.50
Brome-alfalfa pasture*	—	—	1.00	7.55
Native pasture**	—	—	4.00	13.30
Alfalfa-brome hay‡	62.15	2	0.294	18.25
Alfalfa-brome hay‡‡	57.15	2	0.254	14.50
LAND VALUE $130/A ($100 for native)				
Sudangrass pasture	30.00	—	0.50	15.00
Switchgrass pasture	22.50	—	1.00	22.50
Brome-alfalfa pasture*	—	—	3.00	12.10
Native pasture**	—	—	6.25	13.60
Alfalfa-brome hay‡	44.90	1.2	0.49	22.00
Alfalfa-brome hay‡‡	42.40	1.2	0.419	17.75

*Grazed for 4 months between mid-May to mid-Sept (cost prorated)
**Grazed for 5½ months between mid-May to November (cost prorated)
‡Feeding costs $5/T; wastage from feeding, 27%
‡‡Feeding costs $2.50/T; wastage from feeding, 10%

Mid-Summer (Early July to Mid-August)

July and August are the months when growing forage is frequently in short supply because most livestock producers rely on cool-season grasses. Forages are sudangrass, warm-season perennials, cool-season grasses that are semi-dormant, small grain stubble, or hay. The data in Table 2 indicate that sudangrass pasture, bromegrass-alfalfa pasture and switchgrass pasture would provide all the nutrients needed. Warm-season natives and hay should be supplemented by phosphorus and energy. Straw in a stubble field is far short in protein, phosphorus and energy (Table 2). Weeds and grain in a stubble field improve the nutritive value of grain stubble.

Table 5 compares the cost of forage commonly available for this 6-week period. The estimates indicate that forage costs for an animal unit are much lower on sudangrass or brome-alfalfa pasture than with a perennial warm-season grass or hay. Estimates include $9.50 per acre for fertilizer on switchgrass and $10 or $15 on sudangrass but no fertilizer on any of the other forages. Hay costs can be considerably reduced if wastage during the feeding operation is held to a minimum.

Forage recommendations for 6 weeks between early July and mid-August are to use sudangrass, a sorghum-sudan hybrid, a true sudangrass hybrid, or a mixture of soybeans and sudangrass, and rotate grazing. Divide the pasture in two or more parts. Rotate between the parts, or rotate between the mid-summer pasture and the early spring and summer pasture, or rotate between the mid-summer pasture and crop aftermath.

If you prefer perennial grasses, seed switchgrass, Indiangrass or big bluestem alone or in mixture in central and eastern counties for pasture in July and August. Allow ⅔ to 1 acre per animal unit (more acres on low-producing soils and fewer on good-producing areas).

Sudangrass, hybrid sudans, and sorghum-sudan hybrids are annual crops that have a high carrying capacity for 6 to 8 weeks. Some varieties have a high percentage of prussic acid which is poisonous to livestock. New growth contains a higher percentage of prussic acid than older growth. Under continuous grazing, new growth is utilized as it appears, while rotational grazing allows the new growth to age before it is grazed and reduces the hazard of poisoning.

Piper is a variety of sudangrass with low prussic acid content. It is not hazardous to grazing livestock. Consult companies that produce commercial sorghum-sudangrass or hybrid sudans to find out if their hybrids are safe to graze. Hybrids frequently produce more forage, and those low in prussic acid may be preferred to sudangrass.

Soybean-sudangrass pastures have been profitable for both dairy and beef production at Brookings, Dairy cattle were grazed from June 25 to September 16. The pasture was divided into five parts and ten cows per acre were rotated daily. The pasture produced 5,030 pounds of dry matter per acre which produced 5,073 pounds of milk for a net profit of $77.00 per acre. The same crop used as hay produced 4,624 pounds of dry matter, 3,672 pounds of milk and a net profit of $17.85.

In similar pastures, over a 4-year period, an average of 147 pounds of beef was produced from 1.28 tons of forage per acre.

Frequently warm-season grasses such as little bluestem and sideoats grama are dominant on steep slopes and on weakly developed soils. Big bluestem, switchgrass, and Indiangrass are warm-season grasses that are dominant on deep soils with favorable moisture in high range conditions in eastern South Dakota. These grasses make excellent mid-summer pastures. Blue grama and buffalograss are also warm-season grasses, but they are short growing, low yielding species that often become dominant on ordinary over-grazed uplands in central and western South Dakota.

Late Summer (Mid-Aug.-Mid-Sept.)

Cool-season grasses that grew rapidly in May and June and became somewhat dormant in July and August generally resume growth in late August and are productive during late August and September. Most sorghum-sudan hybrids are green and provide good grazing at this time of year. Small grain is harvested by this time and the stubble can be utilized. Straw is far short in protein, phosphorus, and energy (Table 2). Weeds and volunteer grain improve the nutritive value of grain stubble.

The carrying capacity and costs per cow for a 1-month period from mid-August to Mid-September are

Table 6. Carrying capacity and cost of forages and supplements for a cow and calf during a 1-month period in late summer.

FORAGE	A/AU	COST PER ANIMAL UNIT	
		FORAGE	SUPPLEMENT
LAND VALUE $250/A ($150 for native)			
Brome-alfalfa pasture*	0.60	$5.00	$—
Brome-alfalfa pasture**	1.00	5.20	—
Native pasture‡	4.00	9.50	—
Sorghum sudan pasture	0.15	7.50	—
Stubble‡‡	—	—	4.50
LAND VALUE $130/A ($100 for native)			
Brome-alfalfa pasture*	1.20	540	—
Brome-alfalfa pasture**	3.00	8.65	—
Native pasture‡	6.25	9.70	—
Sorghum-sudan	0.30	7.60	—
Stubble‡‡	—	—	4.50

*Grazed intensively for 75 days May-July and Aug-Sept. (costs prorated)
**Grazed less intensively for 4 months between mid-May to mid-Sept. (cost prorated)
‡Pasture grazed for 5½ months between mid-May to Nov. (cost prorated)
‡‡Cost includes 1½ lb/day of 40% protein supplement

Table 7. Carrying capacity and cost of forages and supplements for a cow and calf during a 7-week period after mid-September.

FORAGE	COST PER A	A/AU	COST PER ANIMAL UNIT	
			FORAGE	SUPPLEMENT
LAND VALUE $250 ($150 FOR NATIVE)				
Russian wildrye pasture	$33.85	0.75	$25.40	$—
Native pasture*	—	4.00	13.30	—
Sorghum-sudan pasture	50.00	0.33	16.50	—
Alfalfa-brome hay‡	62.15	0.343	21.30	—
Alfalfa-brome hay‡‡	57.15	0.296	16.90	—
Crop Aftermath**	—	—	—	7.50
LAND VALUE $130 ($100 FOR NATIVE)				
Russian wildrye pasture	24.25	1.00	24.25	—
Native pasture*	—	6.25	15.85	—
Sorghum-sudan pasture	30.00	0.50	15.00	—
Alfalfa-brome hay‡	44.90	0.571	25.65	—
Alfalfa-brome hay‡‡	42.90	0.483	20.70	—
Crop aftermath**	—	—	—	7.50

*Grazed 5½ months between mid-May and Nov. (cost prorated)
**Cost includes 1½ lb/day of 40% protein supplement
‡Feeding costs $5/T and wastage from feeding is 27%
‡‡Feeding costs $2.50/T and wastage from feeding is 10%

given in Table 6. Tame-grass pastures are the most economical. The use of crop aftermath is not as economical as it would seem, because the cost of supplements needed to give the cow a balanced ration are high. The carrying capacity and cost figures for perennial grass pastures for $130-land are those obtained at the Pasture Research Center.

Forage recommendations for mid-August to mid-September are to use the same forages that were used in late spring and early summer—late May to early July. Do not graze tame grasses mixed with alfalfa after mid-September. Grazing after that date may reduce carbohydrate root reserves of the alfalfa so that it may winter injure or winter kill.

If you graze small grain stubble, be sure to supplement it properly in order to get the desired growth on calves or yearlings.

Fall (Mid-Sept.-Nov.)

Forages that can be used during this 6- to 7-week period are crested wheatgrass or Russian wildrye pasture, winter wheat or rye that was seeded early, hay, or crop aftermath.

Sorghum-sudan hybrids were planted on many acres of "diverted acres" in recent years and used as pasture after September 1. Producers have learned that they make good pasture with good nutritional value.

Table 7 compares the cost of forage for a 7-week period after mid-September. The estimates indicate that sorghum-sudan provides forages for the lowest cost per cow. The Russian wildrye pasture estimates include costs of $11.50 per acre for fertilizer which makes it cost more than hay on high-value land. Crop aftermath is low in nutritive value (Table 2) and must be supplemented in order to balance the ration. Supplements are expensive, so crop aftermath properly supplemented is not as cheap as it would seem. Use of crop aftermath also removes plant food that would otherwise be returned to the soil.

Forage recommendations for late September and October are to use crop aftermath, sorghum-sudan, Russian wildrye or native pasture. Be sure to supplement crop aftermath with protein, at least until the calf is weaned and for yearlings. Also provide for replacement of soil nutrients removed in the crop aftermath. Use ¾ to 1½ acres of perennial grass, 4 to 8 acres of native grass or 1/5 to 1/3 acre of sorghum-sudan for each animal unit. Graze continuously. Do not use a perennial grass pasture that you intend to graze early next spring.

The same kinds of pastures used in early spring can be used for pasture during September and October. However, they should be rested for fall use. Crested wheatgrass greens up in September and provides late-fall grazing if ample fall rain is received. Russian wildrye greens up quickly from fall rain and produces green forage for 2 weeks longer than any other grass.

To produce maximum forage yields, pastures need a rest period during the growing season to replenish root reserves. Therefore, pastures grazed late in the fall are not very useful for grazing early the next spring.

PASTURE AND FORAGE SYSTEMS

Use the estimated costs and acres per animal unit (A/AU) in Tables 3 to 7 to estimate costs and acreage required for forage production for about 6½ months. If the estimated carrying capacities or forage yields in the tables are too high, the estimated costs per cow are low and vice versa.

Estimate the cost and acreage requirements for 6½ months by totaling the estimated costs and A/AU of a selected forage from each of the five tables (3 to 7). See Table 8 for an example. Forage costs and acreage requirements in this low-cost system are an estimated $45.85 and 0.945 A for each animal unit. Cost and acreage requirements for a 50-cow herd are 50 times greater or $2,292.50 and 47.25 acres.

Adjust the cost for different land values by subtracting 8% of the land

Table 8. A low cost forage system for 6 to 7 months on land of above-average value.

TABLE NO.	PERIOD	FORAGE	A/AU	COST/COW
3	5 wk.	silage & hay	0.145	$15.25
4	6½ wk.	brome-alfalfa	0.60	8.10
5	6 wk.	sudangrass	0.20	10.00
6	1 mo.	brome-alfalfa	*	5.00
7	7 wk.	crop aftermath	—	7.50
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TOTAL	6-7 mo.		0.945	$45.85

*A/AU accounted for in Table 4.

Table 9. Estimated acreage required for 50-cow herd and cost per animal unit for forage and supplement for 6½ months (mid-April to early November for 18 forage systems.

FORAGE SYSTEM	ACRES FOR 50 COWS								TOTAL 6-7 MO	COST PER AU
	SPRING			SUMMER			FALL	NATIVE		
	SILAGE	HAY	C.W*	BIA**	SW***	SU****	RWR*****	5½ MO		
LAND VALUE $250/A ($150 for native)										
1	4.5	2.75	—	30	—	10	—	—	48	$45.85
2	—	—	35	30	—	10	—	—	75	53.90
3	4.5	2.75	—	30	35	—	—	—	72	58.35
4	—	—	35	30	35	—	—	—	100	66.40
5	4.5	17.5	—	30	—	—	—	—	52	54.10
6	—	14.7	35	30	—	—	—	—	80	62.15
7	4.5	2.75	—	30	—	10	37.5	—	85	63.75
8	—	—	35	30	—	10	37.5	—	113	71.80
9	4.5	2.75	—	30	35	—	37.5	—	110	76.25
10	—	—	35	30	35	—	37.5	—	138	84.30
11	4.5	17.5	—	30	—	—	37.5	—	88	72.00
12	—	14.7	35	30	—	—	37.5	—	117	80.05
13	4.5	2.75	—	50	—	—	—	—	58	44.20
14	—	—	35	50	—	—	—	—	85	52.25
15	4.5	2.75	—	50	—	—	37.5	—	95	62.10
16	—	—	35	50	—	—	37.5	—	122	70.15
17	4.5	2.75	—	—	—	—	—	200	208	66.20
18	—	—	35	—	—	—	—	200	235	74.25
LAND VALUE $130/A ($100 for native)										
1	7.5	4.5	—	60	—	25	—	—	97	56.10
2	—	—	40	60	—	25	—	—	125	55.50
3	7.5	4.5	—	60	50	—	—	—	122	63.60
4	—	—	40	60	50	—	—	—	150	63.00
5	7.5	29.0	—	60	—	—	—	—	97	63.10
6	—	24.5	40	60	—	—	—	—	125	62.50
7	7.5	4.5	—	60	—	25	50	—	147	72.85
8	—	—	40	60	—	25	50	—	175	72.25
9	7.5	4.5	—	60	50	—	50	—	172	80.35
10	—	—	40	60	50	—	50	—	200	79.75
11	7.5	29.0	—	60	—	—	50	—	147	79.85
12	—	24.5	40	60	—	—	50	—	175	79.25
13	7.5	4.5	—	150	—	—	—	—	162	63.35
14	—	—	40	150	—	—	—	—	190	62.75
15	7.5	4.5	—	150	—	—	50	—	212	80.10
16	—	—	40	150	—	—	50	—	240	79.50
17	7.5	4.5	—	—	—	—	—	313	325	73.85
18	—	—	40	—	—	—	—	313	353	73.25

*Crested wheatgrass; **brome and/or intermediate wheatgrass-alfalfa; ***switchgrass; ****sudangrass; *****Russian wildrye.

value ($250, $150, $130 or $100) in Tables 3 to 7 from the cost per acre in the tables. Adjust the acreage requirements by changing the acres per animal unit (A/AU) to reflect the productivity of your land. Estimate the cost per animal unit (AU) by multiplying these two numbers. Example: Table 3 shows cost per acre of crested wheatgrass pasture on $250-land is $32.60 and A/AU is 0.70. Therefore, $32.60 x .70 = $22.82 (cost per AU). Follow this procedure to adjust the cost per AU for $130-land with carrying capacity of 0.8 A/AU: $32.60 - $20.00 (85% of $250) = $12.60; $12.60 + $10.40 (8% of $130) = $23.00 (cost per acre); $23.00 x 0.8 A/AU = $18.40 (forage costs per AU). Note: The annual costs per acre and A/AU of brome and/or intermediate wheatgrass-alfalfa (BIA) and native pastures are given in Table 4. Costs are prorated in Tables 4, 5, and 6 for BIA and Tables 4, 5, 6, and 7 for native pastures.

Estimated acreage requirements for 50-animal units and the annual cost for one animal unit on land of average value and productivity are given in Table 9 for 18 forage systems.

In systems 1 to 12, a bromegrass and/or intermediate wheatgrass-alfalfa (BIA) pasture is used during the periods of peak production (late May to early July and mid-August to mid-September). Early spring forage is hay and silage fed in drylot or a crested wheatgrass pasture. Mid-summer forage is a sudangrass, a perennial warm-season grass such as switchgrass, or alfalfa hay. After mid-September, forage is obtained from small grain stubble or a Russian wildrye pasture.

System 1 involves the use of drylot in April and May, BIA in May-July, sudangrass in July-August, BIA in August-September, and small grain stubble in fall. It has the lowest acreage requirement for forage production and costs the least per cow. It requires protein supplement after mid-September when the cattle go on stubble. Labor requirements are minimal after the cattle go on pasture in late May.

System 2 is the same as system 1 except that crested wheatgrass pasture is used in late April and May. It requires about ½ acre more land for each cow. It costs about $8 more on higher value land but about the same on average value land as system 1. As mentioned earlier, cost per cow in this system can be reduced by mixing alfalfa with the crested wheatgrass and cutting it for hay. System 2 requires less labor in the spring. Protein supplement is needed after mid-September when stock are on stubble.

Systems 3 and 4 are like systems 1 and 2, respectively, except that switchgrass is used instead of sudangrass for a 6-week period in July and August. Switchgrass does not have the carrying capacity of sudangrass; consequently, the acreage required and the cost per cow are both higher than with sudangrass. Again, protein supplement is needed after mid-September when stock are on stubble.

Systems 5 and 6 are like systems 1 and 2 or 3 and 4 except that alfalfa-grass hay is fed for 6 weeks in July and August instead of using sudangrass pasture (systems 1 and 2) or switchgrass pasture (systems 3 and 4). Hay costs more than sudangrass on average or above average land but less than switchgrass on good land.

Systems 7, 8, 9, 10, 11, and 12 are like systems 1, 2, 3, 4, 5, and 6 until mid-September, then a Russian wild- rye pasture is used instead of crop aftermath. No protein supplement is needed and costs per cow are higher. System 10 requires more land and appears to cost more than any other tame-grass system on higher value land. It involves the use of four tame grass pastures—crested wheatgrass, brome and/or intermediate wheatgrass-alfalfa, switchgrass and Russian wildrye. The cost estimates are high because they include about $10 an acre for an annual application of fertilizer on switchgrass and $11.50 an acre on crested wheatgrass and Russian wildrye. As mentioned above, the cost of this system can be reduced $8 or $9 per cow by planting alfalfa with the crested wheatgrass. Similar decreases might be made with Russian wildrye but such mixtures have not been tested extensively in South Dakota.

With the present high price of fertilizer, many people will be tempted to omit nitrogen fertilizer without planting alfalfa. Pasture productivity will be reduced and more acres needed. If productivity is decreased by one-third, acreage requirements for a 50-cow herd on this system increase from 138 to 200 on $250-land without changing the cost per cow. On $130-land, acreage requirements increase from 200 to 265 and cost per cow drops almost $20. The 8% land charge on the additional acres of lower value land is not enough to offset the cost of fertilizer. However, with present livestock numbers, it may be desirable to increase forage production per acre rather than lower it.

Forage systems 13, 14, 15, and 16 differ from forage systems 1 to 12 in that bromegrass and/or intermediate wheatgrass-alfalfa pasture is grazed less intensively for about 4 months instead of being grazed intensively for about 75 days. For example, system 13 is like systems 1, 3, and 5 except that the BIA pasture is managed differently and replaces the sudangrass in system 1, switchgrass in system 3, and hay in system 5. For $130-land, it is estimated that the grass-alfalfa mixture (system 13) requires 3 acres for each animal unit while the grass-alfalfa mixture and switchgrass (system 3) require a total of 2.2 acres each. These are the actual requirements on similar land at the Pasture Research Center in north central South Dakota. Even though the land requirements in system 13 are somewhat higher than those in system 3, the costs in system 13 are lower because alfalfa in the mixture replaces the fertilizer included in the cost of a switchgrass pasture of system 3.

System 14 can be compared, in a similar manner, to systems 2, 4, and 6, while system 15 can be compared to systems 7, 9, and 11, and system 16 with systems 8, 10, and 12.

Systems 17 and 18 include the use of hay and silage in drylot or crested wheatgrass pasture in April and May and native pasture from mid-May to early November. Though land values are estimated to be 60 to 75% of cultivated land, the use of native pasture costs $20 to $25 more per head than the most economical systems and appears to be a relatively expensive method of raising a cow-calf herd. It requires far more land. Interest on investment and taxes are higher than the productivity of the land will support economically.

It is obvious that operators can devise forage systems that will be as good as the ones suggested here. For example, the use of hay can be substituted for crop aftermath or Russian wildrye in the fall. Comparisons in Table 7 indicate that the use of hay instead of crop aftermath in systems 1 to 6 or 13 and 14 increases the cost by about $14 per cow and acreage requirements by about 17 acres for 50 cows in each system on land valued at $250. Use of hay instead of Russian wildrye in systems 7 to 12 or 15 and 16 cuts the cost about $4 per cow and decreases acreage requirements about 20 acres for 50 cows in each system. On $130-land hay costs $18 more per cow and requires 28.5 more acres for 50 cows than crop aftermath. Hay costs about the same as Russian wildrye but lowers acreage requirements about 20 acres for 50 animal units.

It is also obvious that there are thousands of acres of grassland (especially rangeland) that are not included in Table 9 because they do not have the carrying capacity and are not valued as high. For example, rangeland that is valued at $40 per acre may only support 5 animal units on 100 acres. For such an area, the forage costs for a cow would be about $75, and 1000 acres would be required for a 50-cow herd.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the United States Department of Agriculture. Hollis D. Hall, Director of Extension Service, South Dakota State University, Brookings. The South Dakota Cooperative Extension Service offers educational programs and materials to all people without regard to race, color, religion, sex or national origin, and is an Equal Opportunity Employer.

File: 1.4-8—1-75—3M—3687

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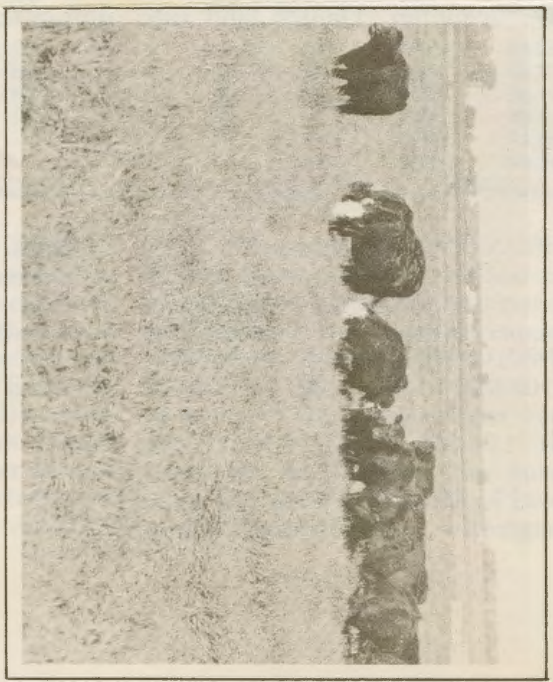

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